EXHIBIT 80

IEc

Expert Statement: Monetary Damages

Groundwater Damages in the Matter of:

Sullivan et al. v. Saint-Gobain Performance Plastics Corporation

Case No. 5:16-cv-00125-GWC

15 December 2017

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INTRODUCTION

This expert statement is submitted in connection with *Sullivan et al. v. Saint-Gobain Performance Plastics Corporation*, 5:16-cv-00125-GWC, and builds on my 31 August 2017 expert statement. In this report I calculate the dollar damages resulting from the release of perfluorooctanoic acid (PFOA)[1] to groundwater in the Town of Bennington and the Village of North Bennington, Vermont, which are not being addressed by the current remedial action plan negotiated by the State of Vermont with Saint-Gobain.

The opinions contained in this report are based on my personal and professional knowledge. My conclusions are expressed to a reasonable degree of certainty and are consistent with the standards of the profession of environmental damage assessment. Staff at Industrial Economics, Incorporated (IEc) provided me with technical and administrative support in completion of this work, all under my direction. I continue to gather information, and the situation continues to evolve. As such, I reserve the right to update this opinion as new information becomes available.

SUMMARY OF OPINION

I was asked to identify reliable and appropriate measures of groundwater damages to the Plaintiffs in this matter, and to estimate the magnitude of monetary damages. My opinions are summarized as follows:

- 10 V.S.A. § 1410(c) describes a cause of action for "unreasonable harm" caused to Vermont's groundwater: "Any person may maintain under this section an action for equitable relief or an action in tort to recover damages, or both, for the unreasonable harm caused by another person withdrawing, diverting or altering the character or quality of groundwater."
- Hundreds of residents of the Town of Bennington and the Village of North Bennington, Vermont, have to date relied on groundwater obtained from individual, private wells as their primary water source.
- The discovery of PFOA in the aquifer underlying these communities has resulted in actions by the State of Vermont to require some of these residents either to seal their wells and connect to one of two municipal water systems, or to operate point-of-entry treatment systems (POETs) to

[1] In this report I refer to the contaminant of concern as "PFOA", which includes PFOA-related contaminants also present in groundwater, including but not limited to PFOS.

limit exposure to these compounds in their well water supply.[2] These actions are being taken in order to protect public health.

- Municipal water hook-up is ongoing, and as yet involves some residences on the western side of what has been described as the zone of contamination (State of Vermont, 2017a). The remedial action plan in the Consent Order does not contemplate providing municipal water connections to a limited number of properties on the western side of the zone of contamination (State of Vermont, 2017a). The State is still negotiating with Saint-Gobain regarding well contamination at residences on the eastern side of the contaminated zone (State of Vermont, 2017a).
- Prior to this contamination event, groundwater in these communities met State and Federal drinking water standards, and was abundant. There is no reason to believe that residents with private wells would have connected to one of the two municipal systems absent this contamination event.
- Bennington and North Bennington operate separate public water utilities. Both of these systems have agreed to add customers to their systems, where possible, to allow residents to avoid the risk of exposure to PFOA.
- In this report I calculate three categories of loss.
- First, while the primary cost of adding residences and businesses to the municipal water systems will be borne by Saint-Gobain as the responsible party, these water users will experience uncompensated "added costs." These added costs will take the form of quarterly water bills, net of certain costs no longer incurred in operating a well.
- Second, residences that cannot be connected to a municipal water system will incur the disamenity of living in a home requiring a POET into the future.
- In addition, all residents of these communities have experienced the loss of a source of clean groundwater, leaving these communities more reliant on the existing municipal water systems and associated remaining water sources.[3]

[2] In some cases, residents first relied on POETs to treat their water, and are now or soon to be connected to one of the two municipal systems.

[3] In the State of Vermont's "Frequently Asked Questions" on their Consent Order with Saint-Gobain, they note "In Corrective Action Area I, the groundwater will be reclassified as Class IV non-potable groundwater in accordance with the Investigation and Remediation of Contaminated Properties Rule and state groundwater protection rules to prohibit future use of this groundwater for human consumptive or other residential purposes in areas served by the municipal water line." (State of Vermont, 2017c).

- The economics literature provides evidence that residents of communities have a "willingness-to-pay" to maintain the option to use groundwater. In this case, the option for residents to use groundwater without treatment has been lost.
- In addition to compensating for added costs, in order to make the public whole for the loss of the option to utilize groundwater, actions should be taken to (1) assure the quality of municipal water systems is maintained; (2) assure the capacity of these systems meets the added demand for water; and (3) assure that the remaining sources of water are protected and enhanced to offset the loss of the community's groundwater resource.
- The costs associated with these actions represent "replacement costs," that is, the cost of actions to fully replace the services previously provided by groundwater. The goal of these replacement actions is to bring these communities back to the position they would have been in absent the groundwater contamination.
- These economic damages approaches are well-suited to measure losses to a group or groups of citizens, or for purposes of establishing damages under the Vermont Groundwater Protection Act and other claims. The calculations performed, assumptions made, and information relied upon are common to all of the Plaintiffs in this matter. As such, addressing losses incurred by members of these communities as a group provides a reasonable and efficient means to establish these damages.
- Based on information available to me at this time, I calculate the present value total of the "added costs" and "replacement costs" damages in this case to be approximately $17.6 million. This is made up of three components:
    - The present value added cost to residences in Bennington and North Bennington of having to pay for municipal water of approximately $4.90 million, net of the cost of owning and operating a well.
    - The present value loss to residences in Bennington and North Bennington who will not be connected to either of the two municipal systems, but instead will continue to use POETs, of approximately $258,000. While Saint-Gobain will pay for the POETs until the PFOA levels are consistently below 20 ppt, these residents may suffer anxiety over the effectiveness of the POETs and many change their behaviors, such as avoiding the use of the water for drinking and cooking. This damage value

reflects these households' willingness-to-pay to have a source of water that is uncontaminated with PFOA.

- The present value of the cost of actions to assure the quality, capacity, and reliability of the Town of Bennington's municipal water system of approximately $12.4 million. As noted above, these communities have experienced a loss in groundwater services, and are now more reliant on the water sources utilized by the Town and Village utilities. I calculate this value considering (1) the cost of changes to the raw water storage and treatment systems used by the Town of Bennington's water system, and (2) the cost of purchasing, through arm's length transactions, properties near the source water collection point. These actions were selected to replace the loss of groundwater as a natural resource available to the community.

Exhibit 1: Present Value Added Cost Calculations

Added Costs for Well Owners Connecting to Municipal Systems	$4,904,276
Losses to Well Owners Not Connecting	$257,674
Replacement Cost for Lost Groundwater Services	$12,420,700
TOTAL	$17,582,651

- The added cost damages reported above represent a lower-bound value for damages, since homeowners may in fact have preferred to continue to get their water from private wells. It also does not incorporate losses to residents with wells that may become contaminated in the future (i.e., testing continues, and additional wells are expected to demonstrate contamination), or owners of developable land above the contaminated aquifer who will now need to utilize the local utilities for their future water supply, rather than individual wells (Siegel, 2017).
- The remainder of this report describes my qualifications, my general understanding of the facts regarding groundwater contamination in Bennington and North Bennington, the approaches I use to calculate groundwater damages, the results of my damage calculations, and the suitability of these approaches to address harms to a common set of Plaintiffs.

QUALIFICATIONS TO OFFER THIS EXPERT OPINION

I am Principal and Director of IEc, an economics and environmental policy consultancy located in Cambridge, Massachusetts. I have been employed with IEc since 1985. I was hired as a full-time Associate with IEc in 1986, promoted to Senior Associate in 1990, and elected to Principal in 1993. From 2000 to 2011 I served as a Managing Director and President of the firm. Prior to joining IEc, I received a Bachelor's in Forestry from the State University of New York at Syracuse in 1984, and a Master's of Forest Science from Yale University in 1986, where my studies focused on environmental and natural resource economics.

My consulting practice focuses on applied natural resource and environmental economics. Specifically, I provide expert support in the assessment of economic damages resulting from adverse changes in the environment, including environmental contamination, as well as the benefits associated with improvements in environmental conditions. My clients have included the United States (U.S.) Department of Justice, the National Oceanic and Atmospheric Administration, the U.S. Environmental Protection Agency, the U.S. Department of Transportation, the U.S. Department of Energy, the U.S. Department of the Interior, numerous U.S. states and Indian Tribes, foreign governments, non-governmental organizations, private companies, and private attorneys.

I have assessed economic losses resulting from the release of oil and other hazardous substances to the environment at a variety of sites throughout the U.S. and the Caribbean. Over the past 30 years I have worked on over 100 environmental damage assessments, including numerous assessments of economic damage resulting from groundwater contamination. I have worked on matters involving private claims for property value diminution due to groundwater contamination, private claims for added costs associated with groundwater contamination, public claims for replacement costs of groundwater resources, valued groundwater resources in the context of cost-benefit analyses of regulatory actions undertaken by the U.S. Department of the Interior under the Endangered Species Act, and provided an expert opinion in the context of an interstate groundwater dispute. In my past work, I have managed and conducted assessments of economic losses associated with contamination of groundwater in Colorado, Connecticut, Illinois, Florida, Kansas, Maine, Massachusetts, Minnesota, Missouri, New Jersey, New Mexico, New York, Ohio, Oklahoma, Pennsylvania, Puerto Rico, Rhode Island, Tennessee, Washington, and the U.S. Virgin Islands. I have assisted and continue to assist several state environmental agencies in the development of approaches to groundwater damage assessment. I have provided expert reports, affidavits, deposition and trial testimony on several aspects of environmental damage assessment, including groundwater damage

assessment and the application of resource equivalency methods. This work has included serving as an expert for both defendants and plaintiffs.

I have published in peer-reviewed journals on topics involving environmental damage assessment and am frequently called upon to discuss this topic at professional meetings. I was a member of the National Academy of Sciences, Transportation Research Board, Committee on Alternative Tanker Designs. I also have served as an expert peer reviewer on applied approaches to environmental damage and benefits assessment for the U.S. Environmental Protection Agency, the U.S. Department of the Interior, and the U.S. Department of Justice; and I served on a review committee for the European Union regarding development of approaches for environmental liability assessment. In addition, I have authored several guidance documents on environmental damage assessment for state and Federal agencies, including guidance on groundwater damage assessment. I am currently serving as an expert witness for the Republic of Nicaragua in an environmental damage case brought by the Republic of Costa Rica before the International Court of Justice.

A partial list of the projects in which I have been involved is included in my Curriculum Vitae (Attachment A). This vita also lists peer-reviewed published papers I have authored. I have presented sworn deposition testimony in one case in the past four years. That testimony was for the U.S. Department of Justice and addressed the appropriate measurement of the economic benefits of environmental restoration (in the matter of: U.S. and the State of Wisconsin v. NCR Corporation, et al., Civil Action No. 1-CV-00910).

GROUNDWATER CONTAMINATION IN BENNINGTON AND NORTH BENNINGTON

In this section I provide a summary of my understanding of the situation. This information is provided for context and to frame the economic damages approaches I use.

- As a result of past activities at industrial facilities in Bennington (1968-1978) and North Bennington (1978-2001), PFOA was released into the environment and came to be located in groundwater underlying both Bennington and North Bennington (MSK Engineering & Design, 2016; Otter Creek Engineering, Inc., 2016).
- Many residents of Bennington and North Bennington, Vermont, have historically relied on groundwater obtained from individual, private wells as their primary water source (MSK Engineering & Design, 2016; Otter Creek Engineering, Inc., 2016).

- Prior to the discovery of widespread PFOA contamination, groundwater in these communities met State and Federal drinking water standards, and was abundant.
- PFOA is considered a toxic contaminant (State of Vermont, 2016; EPA, 2016), and thus its presence has led to the need for actions to protect residents of these communities from further exposure.
- It is expected that PFOA contamination will persist for an indefinite period of time (Siegel, 2017; MSK Engineering & Design, 2016). As it is not known how long the groundwater will remain contaminated, the only solution for these areas is an extension of the municipal water systems.
- Actions taken to date to protect public health include the testing of well water and subsequent reporting on the results of these tests, providing POETs at some residences reliant on well water to remove this contaminant prior to use of the groundwater, and providing bottled water, and most recently, connections for some well owners to one the two municipal water systems (State of Vermont, 2017a).[4]
- To provide a more long-term solution to the health risks associated with exposure to PFOA, the State of Vermont has taken actions to require residents either to seal their wells and connect to one of two municipal water systems, or to operate POETs into the foreseeable future to remove these compounds from their well water.[5] Construction of the additional required infrastructure and tie-ins to provide municipal water to affected parties began in the fall of 2017 (State of Vermont, 2017a).[6]
- Bennington and North Bennington both operate municipal water systems that distribute water in these communities.[7] Both of these systems have agreed to add customers to their systems, where possible.[8]

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[4] In addition, in Bennington several residences that were adjacent to town water lines were hooked up to the municipal system in 2016.

[5] The State is also considering the development of deeper wells for those residences out of range of the municipal systems (State of Vermont, 2017e). At this time it is not known if this option will work as a means to provide uncontaminated water.

[6] Residents placed on municipal water will be required to "seal" their wells, which will render these wells inoperable (except in cases where the well may remain as a means to monitor groundwater). In addition, PFOA contamination is expected to persist in groundwater well into the future. As such, it is unlikely that any current well owners who are sealing their wells will be permitted to return to the use of groundwater.

[7] These communities also provide water to some areas of neighboring towns.

[8] In the case of North Bennington, some of these new connections are outside of the Village limits.

- The Town of Bennington's municipal water system relies on two sources of water: Morgan Spring, a groundwater source located in the center of town, and a surface water source, Bolles Brook, in Woodford, Vermont, to the east of the Town.
- North Bennington separately relies on two related sources of water: a surface water intake on Basin Brook in Shaftsbury, Vermont, and a set of shallow gathering wells located downstream of the surface water source in the same drainage.
- Both municipalities' systems operate water filtration plants, water treatment facilities, water storage facilities, and the distribution system through which water is delivered.
- It is expected that approximately 483 residences and other water users in the Town of Bennington will connect to the Town's utility as a result of PFOA. It is expected that about 52 residences and other water users will connect to the North Bennington utility as a result of PFOA (Town of Bennington, 2017; Village of North Bennington, 2017; MSK Engineering and Design, 2016).
- According to the findings of the State of Vermont and Saint-Gobain in their Consent Order, some residences are too distant or difficult to reach from the current water distribution systems maintained by these municipalities, and thus also will need to continue to operate and maintain POETs into the foreseeable future (State of Vermont, 2017e).[9] At this time it appears that approximately 12 residences fall in this subclass.
- A total of 297 residences in the Town of Bennington and the Village of North Bennington will be forced to take action in the near-term (those who fall in Action Area I), and an additional 250 residences in Action Area II are expected to need to take action once the State and Saint-Gobain reach agreement on responsibility for required corrective action due to PFOA contamination in that area (Dolmetsch, 2017).[10]

[9] As noted earlier, the State is considering the option of deeper wells for these households.

[10] From the State of Vermont's Frequently Asked Questions: "Under the terms of the consent order, Saint-Gobain must complete a site investigation on an expedited schedule. Following that investigation, Saint-Gobain must submit a plan to address PFOA, including a proposed drinking water remedy, no later than 90 days from ANR's approval of the site investigation report if Saint-Gobain and the State reach agreement that Saint-Gobain is responsible for PFOA in this area. Saint-Gobain would then be required to perform corrective actions and provide the permanent drinking water remedy in accordance with a schedule approved by ANR. If the State and Saint-Gobain are unable to reach an agreement, the State will use all authority provided by Vermont law to pursue long-term drinking water solutions for all impacted residents." (State of Vermont, 2017c) In addition, see Siegel 2017, page 1-1.

- The litigation entitled *Sullivan et al. v. Saint-Gobain Performance Plastics Corporation*, 5:16-cv-000125-GWC, has been filed as a putative class action to address various unaddressed harms resulting from Saint-Gobain's PFOA contamination (United States District Court, Sullivan et al. v. Saint-Gobain Performance Plastics, 2017).
- Based on Grand List data, there are roughly 2,150 Bennington and North Bennington residential properties lying above the zone of contamination.[11]
- Based on Census data, there are approximately 8,342 residents within this zone.[12]
- Under the remedial action plan contained in the Consent Order between the State of Vermont and Saint-Gobain, the cost of adding affected residences on the western side of the zone of contamination to the municipal water systems will be primarily borne by Saint-Gobain, as the responsible party. Saint-Gobain will also bear the cost of maintaining and operating POETs for those residences on the western side of the contamination zone that cannot be added to one of the municipal systems (Vermont Agency of Natural Resources, 2017).[13]
- However, these water users will experience uncompensated added costs and a disamenity into the future, including:
    - Added cost damages for those who will now be connected to one of the two municipal water systems. This category of damage reflects the additional out-of-pocket financial burden placed on the harmed parties as a result of groundwater contamination. Specifically, residents of these communities who join the municipal water system will now have to pay a

[11] A shapefile of the boundary of the Zone of Contamination was obtained from the Vermont Department of Environmental Conservation. A list of addresses located in the Bennington and North Bennington Zone of Contamination was obtained from the Bennington Assessors' Office Grand List. Commercial properties were excluded from this list. Data layers were spatially overlaid on ArcGIS.

[12] Census block population data were downloaded from the U.S. Census Bureau's American Community Survey 2015 5-year estimate. Population data for Bennington County were joined to the Census Bureau's TIGER spatial reference data. For census blocks that lie completely within the zone of contamination, 100 percent of the block's population was counted in this estimate. For census blocks that are partially located within this zone, the total population was multiplied by a scaling factor based on the percentage of the block's area lying within the zone of contamination (for example, if 50 percent of a block group lies within the zone of contamination, its total population estimate was multiplied by 0.5).

[13] At some point these residences may become responsible for the costs of operating the POET systems, if "Saint-Gobain has demonstrated a stable or decreasing trend of PFOA levels for eight consecutive rounds of quarterly sampling." (State's Fact Sheet re: Consent Order)

quarterly water bill. These well owners may also be able to avoid some of the costs associated with operating a well.

- Willingness-to-pay damages for those residents who will be unable to join the municipal system, reflecting the amount these residences would pay to have a source of water uncontaminated by PFOA.

- In addition, these and other residents of these communities have experienced the loss of a source of uncontaminated groundwater, leaving these communities more reliant on the existing municipal water systems and associated water sources. These losses are best addressed through enhancement of the existing municipal water systems on which these communities are now reliant.

Approaches to calculate these economic damages – added cost and replacement cost – are described below.

ADDED COST APPROACH

As noted above, in some cases the presence of a hazardous substance in the environment may impose "added costs" on the harmed public. Added costs, also referred to as "averting costs," are widely accepted as a measure of environmental damage (EPA, 2014).

While the primary cost of connecting affected residences and businesses in Bennington to the municipal water systems will be borne by the responsible party, these water users will experience added costs into the future. These changes will come in the form of water bills for those residents who join the municipal water system, net of some expected costs of using well water. Residents who do not receive a connection to the municipal systems will incur the disamenity of having to rely on and manage a POET system to protect the quality of the water they use.

In constructing an added cost model, the first step is to establish a "but-for" condition: that is, the conditions that would exist had PFOA not been found in local wells. In this case, the "but-for" condition reflects the continued use of groundwater via individual wells by all affected residences. This includes, typically, operation of the well-pump and a pressure tank. In some cases residences may also have used a water softener prior to the contamination event. Under this but-for framework, the provision of a municipal hook-up to the residence in effect replaces the well and associated equipment as a source of water.

There was little interest among the affected groundwater users in joining either municipal system prior to this event (communications with operators of the water

systems in Bennington and North Bennington). That is, over the past decade, only a small number of connections were added to these systems, and neither system reports having had many requests for additional service. This fact reflects the preference of these residents for well water, the preference for having an independent source of water, and the desire not to incur the added cost of municipal water.

I assess added costs by considering the following new expenses that will be incurred by households with new connections:

- The number of residences connecting to each municipal water utility.
- The number of residences not being offered a connection to the municipal system. These residents will need to continue to utilize a POET for the foreseeable future.
- Current water rates: in the Town of Bennington this is generally a flat charge per quarter, but for some water customers in the Town of Bennington and all water customers in North Bennington the rate is based on usage.[14] The cost associated with obtaining water from these municipal systems is significant; for example, a household in Bennington that opts to pay the flat rate will pay $532 per year (at current rates) (Bennington water utility rate schedule). The average water consumer in North Bennington will pay $354 per year for this service.[15]
- The expected rate of increase in water rates in the future: At this time, both systems expect increases in future years to be on the order of two to three percent per year, which is consistent with past increases (Personal communication, Joan Pinsonnault, Town of Bennington, review of pattern of historical water rates).

I also consider whether there are any relevant cost savings to these class members associated with provision of municipal water. These avoided cost items likely include:

- Electricity to operate the well pump.

[14] It appears that 2,500 customers in Bennington chose to be billed the flat rate, and 1,130 users chose to be billed based on usage (some of whom are non-residential) (personal communication, Joan Pinsonnault, Town of Bennington). New customers will need to choose at the time of hook-up: if they choose not to have a meter installed at this time, they will need to pay for it at a later date to be billed based on the quantity of water used (personal communication, Joan Pinsonnault).

[15] North Bennington charges all users a $44/year fee associated with a bond assessment, and $4.25/1,000 gallons used (North Bennington Water Utility). The average user consumes about 200 gallons per day, which generates a usage charge of $310.25/year, or a total of $354/year (personal communication, Ted Fela, Village of North Bennington).

- The capital and installation cost of the well pump ($1,300), which will be required once every 17 years.
- The capital and installation cost of the pressure tank ($1,000), which will be required every 25 years.
- The cost of an annual water test for bacteriological contamination (Vermont Department of Health, 2017).[16] While not all residents do this type of testing, it is recommended by the State. Fewer than 20 percent of residents submitted this test on an annual basis (conversation with State of Vermont, Department of Health, Public Health Laboratory).
- The potential savings in homeowners insurance. This saving may be experienced by some residents.[17]
- The cost of capital and installation of a water softening unit, as well as the cost of salt required by the unit. I assume that these units need to be replaced every 15 years, at a cost of $2,000. I understand that 80 percent of households with wells in the Bennington area use such systems, based on conversations with southern Vermont installers of these units, and on an understanding that about 80 percent of wells in the area are screened into bedrock. The bedrock aquifer in this area generally generates well water that benefits from softening.[18]

The information regarding these cost components and the sources of the information are included in Exhibit 2.

As for municipal water rates, some of these cost components may increase over time. For purposes of this analysis, we assume the inflation in these costs will also be 2.0 percent.[19]

As shown in the exhibit below, these costs are netted from the cost of paying municipal water bills.[20] The increased annual costs to water users being connected

[16] The Vermont Department of Health charges $14.00 for a home water test to detect the presence of bacteriological contamination.

[17] Whether or not a particular residence will experience this savings depends on the "protection class" they are currently assigned to (i.e., some residents may already have this discount if, for example, they are near a hydrant), and other factors associated with their insurance policy and provider.

[18] Softeners can reduce hardness, but can introduce unwanted salt to the home's water supply.

[19] The U.S. Federal Reserve has a stated a goal of two percent inflation in the cost of consumer goods (Economic Report of the President, 2017).

[20] It is possible that some residences will experience increased lead levels in tap water as a result of the switching of source water from well water to municipal water (State of Vermont, 2017c). There are provisions in place to test residential tap water. Solutions to this problem, should it occur, include the addition of chemical by the utility to its finished water (to reduce the leaching

to a municipal system is on the order of $113 to $344 for households in the Town of Bennington, and from $0 to $166 for households in the Village of North Bennington. These ranges reflect the location of the household as well as whether the household used a water softener and annually conducted a water test. These estimates of avoided costs are applied to the population of residents who will connect to the municipal systems to calculate total avoided costs.

EXHIBIT 2: ADDED COST CALCULATIONS

Cost Component (all costs annualized), 2017)	Town of Bennington		Village of North Bennington	
	Used Water Softener	Did Not Use Softener	Used Water Softener	Did Not Use Softener
Cost of Pressure Tank Replacement (1)	$40	$40	$40	$40
Cost of Pump Replacement (2)	$78	$78	$78	$78
Cost of Water Softener (3)	$217	0	$217	0
Annual Electric (4)	$47	$47	$47	$47
Annual Bacteria Test (5)	$14	$0	$14	$0
Adjustment for Insurance (6)	$24	$24	$24	$24
Total Cost of Well (annual)	$419	$188	$419	$188
Cost of Town/ Village Water (annual) (7)	$532	$532	$354	$354
Net Cost Change (annual)	$113	$344	-$65	$166

1) Replacement every 25 years, at $1,000. Various quotes.
2) Replacement every 17 years, $1,300. Various quotes.
3) Replacement of equipment every 15 years ($2,000), $7/month for softener. Various quotes/market prices.
4) IEc estimate of energy use for household wells, adjusted for Southern Vermont utility rates ($2.65/month, adjusted to $0.1484/kWh, https://www.greenmountainpower.com/rates/).
5) State of Vermont. Kit A. (http://www.healthvermont.gov).
6) Quote from Co-Operative Insurance Companies, Vermont, discount for areas with hydrants.
7) Current water rates for each system, 2017. For Town residents we assume they select the fixed charge.

These costs will be incurred by previous well users into the future. To calculate the present value of these added costs, I consider the nominal discount rate applicable to private parties involved in this claim. Specifically, I utilize the tax-adjusted cost of capital, based on a 30-year fixed rate conventional mortgage in the Bennington area (based on published rates by the Bank of Bennington). This rate is 4.07 percent annually, based on the current rate on a 30-year fixed price mortgage. Given the deductibility of mortgage interest, the after-tax rate is estimated to be approximately 3.05 percent. I use this rate to reflect residents'

of lead), or the replacement of fixtures that may contain lead. Any fixture replacement will be at the owner's expense.

nominal discount rate for future losses. For existing homeowners, the present value damage estimate reflects the expected added cost associated with paying a water bill for their tenure in the home, as well as the capitalized reduction in home value from this additional expense associated with the home.

As shown in Exhibit 3, the total present value cost per household ranges from $0 to $21,473, or an average of $9,167.[21] Total present value damages for all class members who will be connected to one of the two municipal systems are just over $4.90 million.[22]

EXHIBIT 3: PRESENT VALUE ADDED COST CALCULATIONS

	Town of Bennington		Village of North Bennington	
	Used Water Softener	Did Not Use Softener	Used Water Softener	Did Not Use Softener
Annual Cost Increase	$113	$344	$0	$166
Present Value	$7,041	$21,473	$0	$10,352
Percentage of Residences Applied to	80%	20%	80%	20%
Number of Residences	386	97	42	10
Present Value Increased Cost	$2,717,885	$2,082,868	$0	$103,523
Total Present Value Added Cost				$4,904,276

As noted above, there are currently about a dozen residences for which there is no feasible or cost-effective means to connect them to one of the two municipal systems. These residents will need to continue to use POETs for the foreseeable future. I expect the losses suffered by these residences, reflecting their willingness-to-pay to not have a groundwater source that requires treatment with a POET, will be at least as great as those moving to the municipal systems, or $344 per year (on average). That is, they are no better off – and in fact are likely worse off -- than those residences being connected to the municipal system. This assumption is also consistent with the fact that these residences may ultimately be connected to one of the two municipal systems.

[21] For context, the Census reports the average home value in Bennington to be $209,851. As such, this cost reflects about seven percent of home value.

[22] To test the sensitivity of this result to the assumed period of loss, I estimated damages over 30 years to be $2.04 million. However, I believe the 99-year value is more consistent with the expected period of loss and conventional "perpetual" real estate agreements.

With an expected 12 residences remaining on POETs for the foreseeable future, I estimate their loss to be $21,473/residence, or about $257,674 total present value losses for this subclass.[23]

REPLACEMENT COST APPROACH

While residents of Bennington and North Bennington whose wells were impacted by the presence of PFOA will receive municipal water connections or POETs, the community as a whole has lost a source of clean groundwater. While in this case this groundwater cannot be replaced *in situ*,[24] actions can be taken to replace the full-range of services provided by this resource in order to return the community to the conditions that would have existed absent the contamination event (NRC, 1997).

This category of damages represents "replacement costs." That is, these damages reflect the cost of actions to replace the services previously provided by groundwater. Specifically, I consider the cost of actions to: (1) assure the quality of municipal water is maintained given additional demands on these systems; (2) assure the capacity of these systems meets the added demand for water; and (3) assure that the remaining sources of water are protected and enhanced to off-set the loss of the community's groundwater resource. In this matter I assess reasonable replacement costs by considering:

- Changes in the demand for water in both of the municipal systems.
- Actions to ensure water quality is maintained throughout the municipal systems (for example, through the management of levels of disinfection by-products in tap water).
- Actions to ensure the same production capacity, including reserve capacity, exists within the systems as existed in the but-for condition.
- Actions to ensure source water (raw water) quality is maintained.
- Actions to ensure that these systems are reliable and have the necessary redundancy to minimize service disruption.
- The time period over which these actions would be effective.

[23] According to the Consent Order Frequently Asked Questions (FAQ), there are approximately 12 homes with PFOA levels at or above 20 ppt, where Saint-Gobain must operate or maintain a POET until it is technically feasible to install a replacement well. Source: pages 2-3 under "Corrective Action Area I – Operable Unit B"): https://anrweb.vt.gov/PubDocs/DEC/PFOA/Consent%20Order%20and%20Technical% 20Documents/Consent%20Order/00-2017_07_25_FINAL_Consent%20Order%20Fact% 20Sheet.pdf

[24] In similar circumstances, State Natural Resource Trustees, acting for the public, have "replaced" contaminated groundwater through programs to enhance or protect aquifer recharge. Given the extent of contamination in this matter, we focus instead on the existing substitute water sources.

- The present value cost of these actions, including capital costs as well as operations and maintenance, if any.

To complete this assessment I interviewed officials from both water utilities as well as their outside engineering consultants. I also reviewed available information on long-term planning and capacity utilization reports and data. The goal of this effort was to identify actions that will address the factors above, and which are proximate to the groundwater contamination event. In some cases the officials concluded that no additional actions were needed to meet the objectives above (e.g., improvements to enhance distribution system redundancy). Once a list of required actions was identified, I requested cost estimates from the municipalities' consulting engineers or relied on other information to calculate the cost of the replacement action.

Below I summarize the results of these interviews and information review, for each of the two impacted systems.[25]

Town of Bennington

The Town of Bennington water system managers and outside consultant have identified three actions that will act to improve the reliability of the Town's water system, thus replacing some of the services previously provided by groundwater in the Town of Bennington. These include:

- Purchase of properties around the Bolles Brook intake through arm's length transactions with willing sellers. This will serve to allow for control of land uses on these properties that could impact the Town's water source. I calculate the cost of this project based on the Grand List value for Woodford, Vermont of these properties to be $1,420,700.[26] While land purchase for some of the parcels may not be possible at this time, there also exists the possible use of payments for rights-of-first refusal or purchase of easements.
- Modifications to improve the Bolles Brook water filtration plant to assure water quality. In particular, install a raw water facility tank upstream of the plant (to better manage turbidity spikes and assure access to raw water during high flow events) and equipment and processes to increase the raw water pH of the intake water. These changes will allow a rapid sand filter

[25] In order to accomplish the objective of replacing groundwater services, I would expect that these damages should be placed in an environmental trust account benefiting the Town of Bennington and dedicated to this objective.

[26] The Grand List values for Woodford appear to closely follow market values (State of Vermont, Department of Taxes (2016)).

to run effectively and efficiently. The cost of this project is estimated by the Town to be $6 million.[27]

- Replace the Chapel Road storage tank and install a dedicated line to the tank, to improve system integrity. The cost of this project is estimated by the Town to be $5 million.

The total cost of these actions would be $12,420,700.

The Town sees all three of these projects as acting to protect, preserve, and conserve the remaining water sources, and as the best means to keep the Town's water system robust, reliable, and capable of delivering high quality water.

Purchase of Properties around the Bolles Brook Intake

Private land uses around the Bolles Brook intake could lead to water quality and water security issues in the future (e.g., incompatible land uses or poor waste management). As a result, the Town would like to put in place a mechanism to purchase (or otherwise protect), through arm's length transactions, available privately-held parcels. To calculate the cost of this replacement action, we mapped the relevant parcels and obtained the Grand List values from the Woodford Town Hall.[28] While not all of these parcels would be available today, over time these parcels could be purchased, or conservation and water protection easements could be placed on these parcels or monies could be provided to landowners to improve septic and other waste management systems.

Improvements to Bolles Brook Facility[29]

As noted above, the Town of Bennington has two sources of raw water: Bolles Brook and Morgan Springs. Three issues currently impact the reliability and quality of raw water at the Bolles Brook Water Filtration Plant: spikes in turbidity due to storm surges; filter shut-down due to storm surges; and low pH/alkalinity from Bolles Brook influent (pH 5-5.5). Installation of a raw water storage tank will allow for flow equalization, which will allow the utility to improve the reliability and quality of water from this source. Specifically, through flow equalization the utility will be able to minimize the variability in flow rates[30] and composition of the influent water. Additional benefits include the ability to install pretreatment practices, such as chemical neutralization (the process of adjusting

[27] Cost estimates were provided by Jason Dolmetsch, P.E., President, MSK Engineering and Design, Inc., Bennington, Vermont.

[28] In Vermont, each town's "Grand List" is intended to reflect the market value of all real estate, for purposes of real estate taxation. While equity and uniformity of assessment is considered by the State to be more important than maintaining an overall level of assessment that is close to the market value, Listers generally aim for 90% or more of market value.

[29] This section is based, in part, on information provided by Jason Dolmetsch, consulting engineer to the Town of Bennington's water utility (Personal communication, Dolmetsch).

[30] During storm surges the intake needs to be shut due to turbidity.

pH and alkalinity). Raw water will undergo general screening and grit removal prior to entrance into the tank. The water will then be allowed to collect in the tank for a storage capacity of 48 hours. The proposed plan of 48 hours of storage capacity will address periods of turbidity, and increase the Town's ability to control and raise the level of pH and alkalinity while lowering chemical usage in the treatment process.

Chapel Road Storage Tank

Separately the Town believes it necessary to replace the Chapel Road storage tank and install a dedicated line to the tank, at a cost of $5 million. The Chapel Road tank is near the end of its useful life, and the installation of a dedicated line will improve overall system reliability.

Village of North Bennington

North Bennington has historically limited the addition of new customers to its system (personal communication, Ted Fela). Adding customers as a result of the PFOA event will require allocation of around one-third of their remaining capacity to these users.[31] Information submitted to the State of Vermont by the Village indicates that the Village water system may have been close to capacity (State of Vermont Water Supply Rule, 2017), even prior to adding these users.[32] In addition, the Village has, in the recent past, rejected requests for new connections, presumably at least in part on the basis of protecting its limited surplus capacity. As a result, it is possible that treatment plant upgrades could be needed to assure that surplus treatment capacity remains at the pre-event level and to meet State of Vermont standards for public water utilities.

Representatives of The Village of North Bennington, however, have expressed the opinion that there is no need for expansions or changes to their system to meet the expected future demands imposed by additional users. Appreciating the rights and beliefs of the Village's Water Board, I do not include the cost of restoring surplus capacity for the Village of North Bennington's water system in my damage calculations.

[31] Data submitted to the State indicates that the Village's high demand is around 90-94 percent of its filtration capacity, leaving about 30,000-50,000 gpd in surplus (90-94 percent of rated capacity). If the new connections demand an average of 200 gpd, these users will consume about 11,000 gpd of the remaining surplus.

[32] There are a variety of points in a water supply system that can experience capacity issues when demand increases. This includes source water supply (e.g., the flow rate of a stream), pumping capacity or sustainable aquifer capacity (for groundwater sources), raw water storage, treatment capacity, finished water storage (including the need for pressure balancing), and distribution limits.

Context for the Replacement Cost-based Damage Estimate

To provide context for the replacement cost damage value I present above, I note that Barr Engineering had estimated the cost of groundwater remediation to be between $67.65 and $209.05 million, and contaminated surficial soil excavation at $752 million. As such, the cost of an active groundwater remedy at this site would be five to 17 times the cost of the set of replacement actions described above, and the cost of soil removal would be far in excess of this replacement cost estimate (Barr Engineering, 2017).

THESE APPROACHES ARE WELL SUITED TO VERMONT'S GROUNDWATER PROTECTION ACT AND A PUBLIC REMEDY

The groundwater and economic damages approaches I describe above, addressing both added costs and replacement costs associated with groundwater contamination at this site, appropriately compensate for losses to individual households as well as the communities collectively, through a public remedy to replace lost groundwater services. The calculations to be performed, assumptions made, and information relied upon are common to all of the Plaintiffs in this matter. Given similarities in the losses suffered by the residents and property owners in the zone of contamination, it is reasonable and efficient to calculate these losses using these damages models. I believe that this approach provides a measure of damages consistent with the remedies available under Vermont's Groundwater Protection Act for "unreasonable harm" to groundwater.

COMPENSATION

My 2017 rate for expert services in this case is $375/hour. My rate for testimony in this matter is the same.

INFORMATION RELIED UPON

I considered and relied on the following documents in developing this opinion. I also reviewed various maps (and electronic data sets and geospatial data layers) of the municipal water systems, as well as maps of the PFOA remediation proposed service areas.

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State of Vermont (2017b). Agency of Natural Resources, Department of Environmental Conservation. Fact Sheet, State of Vermont Consent Order with Saint-Gobain. July 26.

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State of Vermont, Agency of Natural Resources, Department of Environmental Conservation (2017d). Interim Measures Corrective Action Plan For Public Water System (PWS) Extensions Corrective Action Area I, Operable Unit A, North Bennington and Bennington, August 11, 2017.

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IEc

ATTACHMENT A: CURRICULUM VITAE OF ROBERT E. UNSWORTH

ROBERT E. UNSWORTH **PRINCIPAL AND DIRECTOR**

Overview

Mr. Unsworth, Principal and Director of Industrial Economics, Incorporated (IEc), is a recognized expert in the field of natural resource economics and environmental damage assessment. In his 32 years of experience he has addressed the full range of issues encountered in environmental damage valuation. From 2005 to 2011 he served as IEc's President, responsible for strategic planning as well as day-today operations. In addition to his consulting practice, he currently serves on the Board of the Student Conservation Association, an organization dedicated to the development of environmental conservation skills and work experience in young people of all backgrounds.

Of particular relevance to this matter, his work has addressed private claims for property value diminution due to groundwater contamination, private claims for added costs associated with groundwater contamination, public claims for replacement costs of groundwater resources, valuation of groundwater resources in the context of cost-benefit analyses of regulatory actions undertaken by the U.S. Department of the Interior under the Endangered Species Act, and addressed economic issues in the context of an interstate dispute involving groundwater resources. Specific examples of Mr. Unsworth's qualifications of relevance to this case include:

- Serving as an expert witness and consultant to a range of water economics matters, including:
    - Providing an expert opinion on the conceptually sound approach to groundwater valuation for the City of Memphis, in the context of an intestate water dispute between Memphis and the State of Mississippi.
    - Providing expert opinions in a wide-range of groundwater contamination cases brought by public trustees for groundwater resources. For example, Mr. Unsworth served as an expert witness in a damage claim brought by the State of Ohio against the U.S. Department of Energy (DOE) for damages associated with radionuclide contamination of groundwater at DOE's former Fernald, Ohio facility, and is currently an expert witness in a series of claims for damages due to MTBE contamination of groundwater in New Jersey.
    - Providing technical support to a claim for damages brought by a community of well owners impacted by hazardous contamination, including the added costs of providing municipal water and the use of POETs.

Mr. Unsworth has testified in the context of environmental litigation and before state commissions, including Vermont's Public Service Board.

Education and Professional Experience

Master of Forest Science, Yale University.

Bachelor of Science *magna cum laude* in Forestry, State University of New York.

Mr. Unsworth has served as a member of several expert panels, including the National Research Council, Transportation Safety Board, Committee to Evaluate Alternative Tanker Designs; the Atlantic States Marine Fisheries Commission, Horseshoe Crab and Tautog Management Committees; European panels on environmental liability assessment; and U.S. Environmental Protection Agency panels on approaches to estimate the economic benefits of the Clean Water Act and changes in atmospheric visibility He is frequently called upon to present on the topic of environmental damage assessment, including groundwater damage assessment.

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Project Experience

Natural Resource Damage Assessment

Examples of Mr. Unsworth's experience in natural resource damage assessment are summarized below.

- For the Hanford Natural Resource Trustee Council, directing the development of an Injury Assessment Plan, a Preliminary Estimate of Damages, and other documents to support planning for one of the most extensive and complex natural resource damage assessments conducted to-date. Injuries considered include terrestrial and aquatic biota, surface water, groundwater, and Tribal lost use services. Trustees include two states, three Tribal governments, and three Federal agencies.
- For the Los Alamos Natural Resource Trustee Council, directing the development of a Damage Assessment Plan, a preliminary injury evaluation, and other documents required to support restoration planning at this site. Resources of concern include groundwater, surface water, terrestrial and aquatic biota, and Tribal lost use services. Trustees include the State of New Mexico, five Federal agencies, and four Pueblo governments. Mr. Unsworth is currently serving as Program Manager for this multi-year, multi-million dollar assessment.
- For State and Federal Trustees, provided technical support in assessing the likely benefits of early restoration projects following the BP Deepwater. Made technical presentations in the context of early restoration settlement negotiations with BP on behalf of the Trustees.
- For the Department of the Interior, assisting in the development of a white paper on issues in assessing cultural lost services in the context of natural resource damage assessment.
- Providing support to the Navajo Nation in assessing impacts due to the Gold King Mine spill.
- Assisting the trustees for Leech Lake, Minnesota in assessing the damages associated with hazardous contamination at that site.
- For the Commonwealth of Massachusetts, developing a general oil spill damage assessment model to be applied to assign damages from small and moderate scale oil spills in terrestrial, aquatic and marine environments.
- For the State of New York, estimated damages resulting from groundwater injuries associated with a catastrophic salt mine collapse. Participated in settlement negotiations with the responsible party.
- For various trustees, providing support in assessing the natural resource damage assessment credits to be assigned to early restoration actions taken in several large scale damage assessments.
- For the U.S. Department of Energy and the U.S. Department of Justice, provided expert testimony and technical support in settlement negotiations in a claim brought by the State of Ohio against the U.S. for groundwater damages resulting from radionuclide releases from the Fernald Ohio site.
- For the U.S. Department of Justice, U.S. Attorney's Office, and the U.S. Forest Service, assessed natural resource damages associated with several large-scale wildland fires, including the Moonlight, Storrie, Big Creek, Freds, Sims and Witch fires. Provided expert deposition testimony in several of these cases.
- For the City of San Diego, assessed natural resource and other economic damages associated with the Witch and Guejito fires. Developed expert opinion on damages and assisted in settlement negotiations.
- For Sonoma County, California, assessed natural resource damages associated with the Geyser's fire. Assisted in settlement negotiations.

- For the Territorial Government of the U.S. Virgin Islands, provided an expert opinion and expert testimony regarding natural resource damages resulting from groundwater contamination at the Tutu well fields site on St. Thomas. Research considered added costs, the public's willingness to pay for a replacement water supply, and the non-use values associated with the contaminated aquifer.
- For the U.S. Department of Justice and the U.S. Army, assessed damages associated with groundwater contamination at the Twin Cities Army Ammunitions Plant in Minnesota. Assisted in settlement negotiations between the Federal government and the state.
- For the State of New York, assessed groundwater damages associated with a large-scale salt mine collapse.
- For the States of Kansas, Oklahoma, and Missouri, provided an expert opinion in the context of a bankruptcy proceeding as to groundwater damages due to mining activity in the Tristate Mining district.
- For the State of New Jersey, provided expert opinions of groundwater damages at over a dozen sites in the State.
- Assisting in the resolution of a claim for ecological injury and recreational fishing losses resulting from the release of PCBs to Lake Hartwell, South Carolina/Georgia, and an associated tributary. Provided technical support to a cooperative assessment of damages and in the development of a formal Restoration and Compensation Determination Plan.
- Assisting in the development of a preliminary damage estimate and providing technical support to negotiations between Trustees and the responsible party at the Palmerton Zinc Superfund site in Pennsylvania. Categories of loss considered include ecological services associated with injured forested and aquatic ecosystems, as well as recreational fishing, hunting and timber harvest opportunities.
- Assisting in a cooperative assessment of damages due to the release of mercury, PCBs, and radionuclides at Oak Ridge Reservation in Tennessee. Constructed a habitat equivalency analysis for aquatic injuries, and assessed the scale of ecological and human use restoration credits provided by a large parcel of forested land at the site. Currently working with the U.S. Department of Energy and the State of Tennessee to resolve claims for groundwater damages as well as damages associated with remaining terrestrial and aquatic injuries.
- Serving as an expert for the U.S. Department of Justice and the Navy on the economic valuation of injuries to the Allen Harbor clam fishery in Rhode Island, as well as damages associated with contamination of groundwater at the site.
- Serving as an expert for the U.S. Department of Justice and the Army on the economic valuation of contamination of groundwater at the Rocky Mountain Arsenal site in Colorado.
- Assessing a proposed set of restoration options offered by Maine Yankee to compensate for injury to groundwater and marine resources at this former nuclear powered generating station.
- Assisting the States of New Jersey, Massachusetts, and Missouri in the development of guidance for natural resource damage assessment associated with injury to groundwater and habitat resources.
- Providing technical support to a cooperative assessment of damages associated with a large-scale bird kill at Lake Apopka, Florida.
- Providing technical support to the National Park Service in the assessment of damages due to an oil spill on the Obed River, Tennessee.

- Directing efforts to assess natural resource damages due to the collapse of a major coal ash storage impoundment on the Tennessee River in Tennessee.
- Conducting and managing various damage assessment activities and developing a formal, publicly released plan for the assessment of damages and the development of restoration options associated with injuries to the Grand Calumet River and Indiana Harbor in northwest Indiana.
- Directing an assessment of economic damages to Fish Creek in Indiana as a result of a fuel oil pipeline break. This assessment focused on potential damages associated with a federally listed endangered species in the creek.
- Assisting New York State in negotiations regarding recreational fishing losses due to the release of mirex to Lake Ontario. Also conducted a source allocation of PCBs, dioxins and mirex in the Niagara River and Lake Ontario, and assessed the likely persistence of these contaminants in Lake Ontario.
- Assessing damages to natural resources resulting from the release of PCBs to the Housatonic River in Massachusetts and Connecticut. Assisting the trustees in settlement negotiations. Assisting in the development of a Restoration Project Selection Criteria document and in a Programmatic Environmental Assessment under NEPA for restoration actions at this site.
- Developing a guidance manual on the use of economics in natural resource damage assessment, and conducting a series of training sessions on this topic for the U.S. Fish and Wildlife Service.
- Providing technical and managerial support in the Federal effort to estimate economic damages resulting from the *Exxon Valdez* oil spill. This included assisting in the preparation and analysis of results from a nationwide contingent valuation survey designed to estimate changes in the passive-use value of Prince William Sound as a result of this oil spill.
- Participating in a cooperative damage assessment at the John C. Heinz National Wildlife Refuge, Philadelphia, Pennsylvania. This effort involves assessment of ecological and human use losses resulting from an oil pipeline spill within the Refuge.
- Providing general case management support to Federal and tribal trustees pursuing a claim for natural resource damages associated with mine tailings-related injuries to the Cheyenne River in South Dakota. This support included development of case strategy, participation in settlement negotiations, and preparation for a focused damage assessment.
- Providing technical and economic support to the Trustees of Lavaca Bay, Texas. Efforts include estimating economic losses suffered by recreational anglers and losses resulting from increased dredging costs associated with mercury contaminated sediments; case management support, including direction of a geostatistical analysis of mercury contamination of bay sediments and direction of a detailed review of historical releases from the site; and developing a draft preassessment screening document.
- Providing case strategy and technical support to the National Park Service in assessment of damages to Grant-Kohrs National Historical Site, Deer Lodge, Montana, resulting from contamination of portions of the Park with mining-related wastes.
- Providing a technical report and affidavit for the U.S. Department of the Interior, National Park Service, regarding economic damages associated with PCB contamination of Valley Creek in Valley Forge National Park.
- Developing a guidance document on damage assessment under Section 19(jj) of the Park Service Protection Act, for the National Park Service's Damage Assessment group.

- Providing support to a hedonic property valuation study designed to assess the impact of PCB contamination on housing values in New Bedford, MA.
- Preparing a formal preassessment screen and damage assessment plan for the PCB-contaminated Hudson River site for Federal and state trustee agencies. Directed the development of a recreational fishing damage model and damage estimates.
- Providing support to the National Oceanic Atmospheric Administration in the development of expedited damage assessment regulations and guidelines under the Oil Pollution Act of 1990.
- Assisting in the analysis of settlement components to support trustee claims arising from the January 2, 1990 Arthur Kill, New York Harbor oil spill.
- Assisting the State of Florida in the development of state guidelines for the conduct of natural resource damage assessments following major oil spills.
- Assisting the State of New York in the development of a natural resource damage assessment plan for the Onondaga Lake System.
- Providing an Expert Witness Narrative for the U.S. Department of Justice and National Oceanic Atmospheric Administration on the application of the habitat equivalency approach to the assessment of natural resource damages resulting from the Blackbird Mine site in Idaho.
- Providing technical and expert witness preparation support to the U.S. Department of the Interior, Fish and Wildlife Service, and the Department of Justice in natural resource damage claims resulting from the release of asbestos and other hazardous substances in the Great Swamp National Wildlife Refuge, New Jersey.
- Providing technical and expert witness preparation support to the Department of Justice and National Oceanic Atmospheric Administration to support claims arising from the grounding of the freighter Elpis in the Key Largo Natural Marine Sanctuary, Florida.
- Providing litigation preparation and expert witness support to National Oceanic Atmospheric Administration and the U.S. Department of Justice to support claims for injury to marine bird populations resulting from the Apex Houston oil spill, California.
- Providing technical support to National Oceanic Atmospheric Administration in the development of a contract management system to facilitate tracking and recovery of costs incurred in the conduct of natural resource damage assessment cases.
- In addition to the above cases, provided damage assessment and case strategy support at over 50 other sites in the U.S. and Caribbean, such as the Bayou Meto ("Vertac") dioxin site in Arkansas; Saginaw Bay in Michigan; Elliott Bay in Seattle; Jamaica Bay, Newtown Creek, Westside site, and Buffalo River, New York; SRS site in Connecticut; White River in Indiana; Union City site in Indiana; Holden Mine and Upper Columbia River sites, Washington; Metal Bank, Pennsylvania; Midnight Mine, Idaho; Sauget site, Illinois; Saltville, South River and Avtex sites in Virginia; Calf Pasture Point, Rhode Island; Acorn Fork in Kentucky; Colrain Acid Spill, Massachusetts; Koch Oil site, Minnesota; Christina River and several other confidential sites in Delaware.
- In addition to the above cases, providing technical support in the development of damage claims for tribal resources, such as Clark Fork River Basin of western Montana for the Confederated Salish and Kootenai Tribes of the Flathead Reservation; along the Cheyenne River in South Dakota for the Cheyenne River Sioux Tribe; in Akwesasne for the St. Regis Mohawk Tribe, Massena, New York; for the Penobscot Nation, Penobscot River, Maine; Spokane Tribe of Indians and the Confederated Tribes of the Colville Reservation for the Midnight Mine site, and the Upper Columbia River site; for the Suquamish Tribe for damages associated with

the Point Wells oil spill and the Duwamish River site; for the Wampanoag on Martha's Vineyard following the *Bouchard* oil spill in Buzzards Bay, Massachusetts; for the Leech Lake Band of Ojibwa at the St. Regis Paper site; and for the Navajo Nation for impacts due to the Gold King Mine release. Mr. Unsworth has also provided technical support to the U.S. Department of Justice (representing the U.S. as defendant) for natural resource damage claims brought by the Quapaw Nation.

Private and State Claims for Damages

Mr. Unsworth provides technical and case strategy support in the context of private claims for damages associated with environmental contamination, oil spills, and forest fires, and other changes in the natural environment and natural resources. Examples of this work include:

- Assessing the economic impacts to Mississippi associated with groundwater withdrawals by the City of Memphis. With Dr. Raymond Kopp, provided expert testimony for the defendant, the City of Memphis and Memphis Light, Gas and Power, on the correct approach to value any economic impacts to Mississippi. Case was ultimately dismissed.
- Assessed the damages to a private landowner in New Jersey resulting from the Warren Grove Gunnery Range wildland fire. Provided expert testimony for the U.S. Air Force and Department of Justice as defendants in this matter on the correct approach to value the plaintiff's losses.
- Serving as an expert in the valuation of losses suffered by lobstermen impacted by the collapse of the western Long Island Sound lobster fishery.
- Serving as an expert in assessing damages to residential property owners associated with air emissions from a meat packing plant.
- Providing technical support, in cooperation with Dr. Raymond Kopp, to an assessment of added costs and property value losses associated with groundwater contamination of a residential neighborhood in suburban Chicago.
- Assessing the impacts on residential property values resulting from a plume of petroleum products under a residential neighborhood in Indiana.
- Estimating the diminution in value of a potential real estate development associated with groundwater contamination at a site in the Caribbean.
- Serving as an expert witness in a private claim for property value diminution resulting from the presence of contaminated groundwater at a site in Lakeland, FL. Mr. Unsworth applied hedonic property value techniques as well as benefits transfer to estimate the magnitude of the loss to homeowners at this site. He also provided support in estimation of the size of the class of plaintiffs who would benefit from the settlement.

Primary Economic Research

Mr. Unsworth has directed a wide-range of primary research efforts in the field of environmental and resource economics. Examples of this work include:

- Directing a random utility analysis of economic losses resulting from contamination of Onondaga Lake, N.Y. This study combines existing data from a 1980s survey of recreational angling behavior with recently collected data to estimate economic welfare losses to the citizens of New York State.

- Directing a multi-year study on the economic value of visits to a range of National Park units. Studies include stated preference surveys at two historic forts in Charleston, S.C.; a random utility model of beach visitation, including temporal substitution, in Texas; and a multi-site, revealed preference study in Southern Utah.
- Directing a series of surveys to gather data to support a claim for damages to the visitor experience at historic El Morro fort in San Juan, Puerto Rico. Damages in this case resulted from the presence of a grounded Russian cement freighter, which was hard-aground off the Fort for nearly five months.
- Managing a series of studies for the Electric Power Research Institute designed to estimate the magnitude of economic damage that could result from long-term climate change. Market sectors analyzed include coastal development, agriculture, recreation, and commercial fishing.
- Managing a series of studies to assess the public's perceptions and attitudes toward the potential ecological effects of climate change. This effort involves a team of academic economists, psychologists, survey researchers and physical and biological scientists, and includes a range of research approaches to address this issue.
- Assessing the regional economic contribution of beach use on the Texas Gulf Coast. This research effort included development and implementation of a telephone survey to determine the number of trips taken to various beaches in Texas, as well as consumer expenditures associated with those trips.

Regulatory Economics

Examples of Mr. Unsworth's work in the area of regulatory economics include:

- For the State of Tennessee, developed a guidance document on the application of economics to decision-making under the Clean Water Act's anti-degradation standards (i.e., justifying whether the economic and social benefits of the project are significant enough to justify the proposed degradation).
- For the California Energy Commission, assessing the state of the science for monetizing the ecological impacts associated with once-through cooling at electricity generating facilities.
- For the Department of the Interior's Office of Surface Mining, developed a regulatory impact analysis and economic and social portions of the environmental impact statement for the revised Stream Protection Rule rulemaking. This effort involved working with a variety of expert subcontractors addressing coal market economics, coal mine engineering, and regional economics.
- Conducting an assessment of potential changes in ecological and human use services within a bay system in California resulting from changes in cooling technology at two large electricity generating facilities.
- Conducting an economic assessment of management alternatives for the Environmental Impact Statement on the incidental take of small numbers of Florida manatees resulting from government programs related to watercraft operation and watercraft access in the State of Florida.
- Participating in developing a programmatic Environmental Impact Statement of Coast Guard actions under the Oil Pollution Act to enhance oil spill response capabilities.
- Directing a series of analyses of the economic efficiency (social welfare) and regional economic effect of critical habitat designation under the Endangered Species Act. Over 50 separate analyses to date, involving habitat throughout the continental U.S and Hawaii. Many of these studies have been conducted under tight court-ordered deadlines.

- Providing guidance to the U.S. Fish and Wildlife Service on the legal requirements for, and appropriate economic approach to, analyses of relicensing proposals for hydropower projects.
- Managing a meta-analysis of 150 contingent valuation and travel cost-based sport fishing valuation studies in order to provide an analytic tool to be used in damage assessment and policy analyses conducted by the U.S. Department of the Interior.
- Supporting the development of an analytical framework for assessing the costs and economic, environmental, and human health benefits associated with regulatory initiatives intended to improve pipeline performance and safety for the Department of Transportation's Office of Pipeline Safety.
- Providing technical and administrative support to the National Oceanic Atmospheric Administration, including support in selecting methods that could be used to estimate economic damages; determining the strengths and weaknesses of each relevant assessment methodology for the determination of damages to a variety of resource categories; and selecting principal investigators to perform these damage assessments.
- Managing efforts to compile review and apply human health and environmental benefit estimates, models, and data sets to support retrospective and prospective benefits assessment under Section 812 of the Clean Air Act.
- Developing and implementing an ecological benefits assessment approach based on probabilistic economic benefit assessment for use in the Environmental Protection Agency's chemical risk management review process.
- Conducting an analysis for the Environmental Protection Agency of the economic benefits that would result from proposed pharmaceutical industry effluent guidelines.
- Estimating the economic benefits associated with environmental quality improvements that could result from reductions in the release of chloroparaffins to three representative aquatic systems.
- Managing a series of case studies for the Environmental Protection Agency to assess the extent to which firms have closed operations as a result of the Clean Air Act, and to identify factors that could be used to predict such closures.
- Managing an economic analysis for the Environmental Protection Agency of the impact on the integrated U.S. steel industry of proposed regulations limiting emissions of hazardous air pollutants.
- Managing an assessment for the Environmental Protection Agency of financial, regulatory, legislative, and market factors facing chlorofluorocarbon producers and users in moving to production and use of non-CFC substitutes.
- Managing the assessment of social costs and economic impacts for the Regulatory Impact Analysis of regulations restricting land disposal of hazardous wastes.
- Assisting in an analysis of the economic impacts of regulations constraining the burning of hazardous waste-as-fuel in industrial boilers and furnaces for the Environmental Protection Agency.
- Providing technical and econometric analysis to support expert testimony for the American Newspaper Publishers Association in hearings before the U.S. Postal Rate Commission.

Public Policy Analysis

Examples of Mr. Unsworth's work in the field of public policy analysis include:

- For the Atlanta Regional Commission, directed the development of a linked hydrological-economic model of the regional and national economic effects of changes in management regime by the Corps of Engineers Buford Dam Project (Lake Lanier).
- For the Kaibab Paiute Tribe, assessing the economic benefits to the State of Utah of a water pipeline right-of-way across the Kaibab Paiute Indian Reservation.
- For the U.S. Department of the Interior, Bureau of Ocean Energy Management, directed substantial updates to the Bureau's Offshore Environmental Cost Model (OECM) and MarketSim models. The OECM allows the Bureau to understand the environmental and social costs and benefits of varying offshore oil and gas development leasing scenarios. The MarketSim model allows for an understanding of the market implications of offshore oil and gas leasing by the U.S. Department of the Interior.
- For the Confederated Tribes of the Umatilla Indian Reservation, estimated the economic benefits associated with enhanced fisheries management and other ecosystem service benefits of the proposed Columbia River Water Exchange Project.
- For the U.S. Department of the Interior, Minerals Management Service, assessed the comparative externalities associated with a range of conventional and offshore renewable energy sources.
- Assisting the Navajo Nation in understanding the level of use payment due to the Hopi Nation under the existing agreement for partition of Navajo and Hopi lands.
- Conducted a study of the economic benefits that have resulted from the successful restoration of the Atlantic coast striped bass fishery.
- Directing an analysis of the regional economic and social impacts of efforts to reintroduce the Mexican wolf to Arizona and New Mexico.
- Conducting an economic analysis of piping plover recovery activities on the Atlantic coast, for the U.S. Department of the Interior, Fish and Wildlife Service. The paper that will result from this research will consider regional economic impacts as well as welfare effects at six case study sites.
- Conducting a study to assess the likely effect of a change in the departure point for Fort Sumter on Park visitation and the local economy. This study involved a series of in-person surveys with Park visitors and tourists in Charleston, S.C.
- Directing a study of the regional welfare economic importance of the horseshoe crab. This study considered the role the crab plays on the pharmaceutical industry, ecotourism, and the commercial fishing industry, and estimated jobs, economic activity, and welfare values associated with each of these uses of the crab.
- Assessing the regional economic impact that would result from the proposed Aldo Leopold National Wildlife Refuge, Wisconsin. Considered the likely baseline use of the area that would be included in the extant boundaries of the Refuge, under several scenarios.
- Assessing the role the Monomoy National Wildlife Refuge plays in the local economy of Chatham, Massachusetts, and in the entire Cape Cod region. Constructed a set of response functions that describe the change in regional economic conditions (i.e., jobs, revenues, etc.) that would result from various changes in allowed uses of the Refuge.
- Assessing the regional economic importance of four National Wildlife Refuges near Bristol Bay, Alaska.
- Estimating the value of recreational fishing improvements associated with proposals to increase water temperatures below a dam on the Guadalupe River in Texas. The analysis used benefits transfer techniques

and studies of fish populations and fishing activity to estimate increased angler days and related welfare benefits.

- Developing estimates of the contribution to the local economy of the Necedah National Wildlife Refuge in central Wisconsin, for the U.S. Fish and Wildlife Service.
- Developing an analysis of flowage (i.e., flood water) easement valuation, including the role of less-than-fee acquisition in non-structural flood control, for the U.S. Department of the Interior, Fish and Wildlife Service.
- Developed a report describing the potential uses of welfare economics in the assessment of hydropower dam projects for the World Commission on Dams, South Africa.
- Reviewing and providing technical comments for the World Bank on the environmental and human health valuation methodologies used in a draft National Environmental Action Plan for Moldova.
- Assessing the potential magnitude of market and non-market economic damages from the loss of forest land in the southeastern United States expected to result from climate change.
- Managing a screening analysis to determine the degree of financial burden imposed on Massachusetts' cities and towns as a result of existing and proposed state and federal environmental requirements.
- Participating in a review of the characteristics and effectiveness of non-regulatory agricultural non-point source reduction programs run by various state authorities.
- Conducting an assessment of historical applications of hazardous substance release events data in environmental policy analysis, as part of an EPA effort to assess the needs for a chemical accident prevention database.
- Managing a data gathering effort to support an assessment of the marginal impact of federally mandated materials separation requirements on proposed municipal solid waste combustion facilities.
- Managing an analysis of consumer purchasing behavior in response to a variety of municipal solid waste management initiatives.
- Managing the development of a computer software package to be used by Local Emergency Planning Committees to set priorities under SARA Title III.
- Developing a chemical and fuel input-output model of the U.S. economy, for use in estimating chemical and fuel expenditures by manufacturing and non-manufacturing facilities.
- Analyzing the structure of the commercial hazardous waste treatment and disposal industry to support an assessment of the impact of federal regulations on this industry.
- Assisting in the preparation of a long-term forecast of capacity for various commercially available hazardous waste treatment technologies, including an assessment of the impact of proposed regulations on capacity.

Publications and Presentations

Mendelsohn, Robert, Daniel Hellerstein,Michael Huguenin, Richard Brazee, and R. Unsworth, 1992, "Measuring Hazardous Waste Damages with Panel Models," *Journal of Environmental Economics and Management* 22:259-271.

Bishop, Richard and Robert Unsworth, 1994, "Assessing Natural Resource Damages Using Environmental Annuities," *Ecological Economics* 11:35-41.

Environmental Performance of Tanker Designs in Collision and Grounding: Method for Comparison. Committee for Evaluation Double-Hull Tanker Design Alternatives, Marine Board, Transportation Research Board, The National Academies. Washington, DC. 2001.

Issues and Environmental Impacts Associated with Once-Through Cooling at California's Coastal Power Plants, Support Studies and Technical Appendices. Appendix E: Economic Costs of Once-Through Cooling Impacts. California Energy Commission, Staff Report, June 2005. CEC-700-2005-013-AP-A.

Issues and Environmental Impacts Associated with Once-Through Cooling at California's Coastal Power Plants , in support of the *2005 Environmental Performance* Report and *2005 Integrated Energy Policy Report* (Docket 04-Iep-1). California Energy Commission, Staff Report, June 2005. CEC-700-2005-013 Chapter 7.

Economic Valuation of Natural Resource Damages: Groundwater. Presentation to the Law Seminars International, Natural Resource Damages Litigation. Santa Fe, NM, July 9-10, 2009

Equivalency Methods in Natural Resource Damage Assessment. Presentation to the Law Seminars International, Natural Resource Damages. Newark, NJ, November 12-13, 2009

Factors Trustees Consider in Selecting Damage Assessment Approaches. Presentation to the Fourth Annual Advanced Conference on Natural Resource Damages, Law Seminars International. Santa Fe, NM, July 15-16, 2010.

Identifying and Accounting for Cultural Use of Natural Resources in the NRDAR Process, Economic and Other Methodologies. Presentation to the State and Tribal Government Working Group, 2011 Natural Resource Damage Assessment and Restoration Workgroup. Albuquerque, NM, February 15-16, 2011.

Assessment of Lost Cultural Use in the NRDAR Process. Presentation to the DOI Annual NRDA Restoration Workshop, Tribal Session. Phoenix, AZ, March 28, 2011.

An Introduction to Tribal Natural Resource Damage Claims. Prepared (with Dr. Gerald (Taiaiake) Alfred) for the Law Seminars International Conference on Natural Resource Damages. Santa Fe, NM, July 14-15, 2011.

Thoughts on Early Restoration and the Measurement of the Benefits of Enhanced Remediation in the Context of Natural Resource Damage Assessment. Presentation to the Ad-Hoc Industry Natural Resource Damage Group 8th Annual Natural Resource Damage Symposium. Washington, DC, October 25-26, 2011.

Genova, Leslie, Robert E. Unsworth, and David S. Brookshire. 2012 "Impacts of Endangered Species Protection on Water Management, Allocation and Use in New Mexico." In: Water Policy in New Mexico: Addressing the Challenge of an Uncertain Future. Resources for the Future Press, Washington, DC.

Natural Resource Damage Claims Using Habitat and Resource Equivalency: The Case of Wildland Fire. Law Seminars International, Natural Resource Damages: *Evolving strategic, tactical and substantive issues*. Washington, DC, February 14-15, 2013.

Natural Resource Damage Assessment in the Context of Tribal Trusteeship. With Robert Unsworth, Leah Shearer, Leslie Genova, and Nadia Martin, Law Seminars International, Natural Resource Damages: Santa Fe, NM, July 19, 2013.

California Assembly Bill 1492: An Economist's View of Implications for Wildland Fire Damages Claims. Wildland Fire Litigation Conference. Monterey, CA, April 21, 2013.

Trustee Considerations in Applying Non-use Valuation Methods for Purposes of NRDA. Law Seminars International, 8th Annual Advanced Conference on Litigating Natural Resource Damages (NRD), Santa Fe, NM, 24-25 July 2014.

An Introduction to Natural Resource Damage Assessment. Regional Response Team III. Virginia Beach, VA May 20, 2015.

"Experience of remedial measures taken after an armed conflict." Seminar on the Protection of the Environment in relation to Armed Conflict. For: the Permanent Missions to the United Nations of Sweden, Denmark, Finland, Iceland and Norway, Rutgers University, the Environmental Law Institute and the

International Union for Conservation of Nature World Commission on Environmental Law, New York, NY, 29 October 2015.

"The Role of Science and Economics to Advance Tribal Interests in an Uncertain World." With Jane Israel. 2016 Tribal Lands & Environment Forum: A National Conversation on Tribal land and Water Resources. August 17, 2016.

"Natural Resource Damage Assessment: Groundwater" For: Invited Regulatory Development Session. State of Vermont, Department of Environmental Conservation. 24 August 2016.